

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

WHITHAM, CURTIS & WHITHAM

DEC 13 1999

PCT

To: KEVIN A. REIF
WHITHAM, CURTIS & WHITHAM
RESTON INTERNATIONAL CENTER
11800 SUNRISE VALLEY DRIVE, SUITE 900
RESTON VA 20191

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing
(day/month/year)

10 DEC 1999

Applicant's or agent's file reference

VTIP 96-037

IMPORTANT NOTIFICATION

International application No.

PCT/US98/20594

International filing date (day/month/year)

30 SEPTEMBER 1998

Priority Date (day/month/year)

30 SEPTEMBER 1997

Applicant

VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

STEVEN LOKE

Telephone No. (703) 308-4920

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To: KEVIN A. REIF
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PATENT COOPERATION TREATY

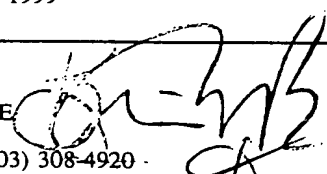
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference VTIP 96-037	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US98/20594	International filing date (day/month/year) 30 SEPTEMBER 1998	Priority date (day/month/year) 30 SEPTEMBER 1997
International Patent Classification (IPC) or national classification and IPC IPC(6): H01L 29/74, 31/111 and US Cl.: 257/107, 133, 135, 138, 139, 140, 146, 147, 163, 177		
Applicant VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of <u>5</u> sheets. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of <u>0</u> sheets.
3. This report contains indications relating to the following items: I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of report with regard to novelty, inventive step or industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application

Date of submission of the demand 08 APRIL 1999	Date of completion of this report 20 NOVEMBER 1999
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer STEPHEN LOKE  Telephone No. (703) 308-4920

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US98/20594

I. Basis of the report

1. This report has been drawn on the basis of *(Substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments)*:

- ☒ the international application as originally filed.
- ☒ the description, pages 1-22 , as originally filed.
pages NONE , filed with the demand.
pages NONE , filed with the letter of _____.
pages _____ , filed with the letter of _____.
- ☒ the claims, Nos. 1-32 , as originally filed.
Nos. NONE , as amended under Article 19.
Nos. NONE , filed with the demand.
Nos. NONE , filed with the letter of _____.
Nos. _____ , filed with the letter of _____.
- ☒ the drawings, sheets/~~fig~~ 1-24 , as originally filed.
sheets/~~fig~~ NONE , filed with the demand.
sheets/~~fig~~ NONE , filed with the letter of _____.
sheets/~~fig~~ _____ , filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

- ☒ the description, pages None .
- ☒ the claims, Nos. None .
- ☒ the drawings, sheets/~~fig~~ None .

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the ~~Supplemental Box~~ Additional observations below (Rule 70.2(c)).

4. Additional observations, if necessary:

NONE

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US98/20594

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. STATEMENT**

Novelty (N)	Claims <u>1-32</u>	YES
	Claims <u>NONE</u>	NO
Inventive Step (IS)	Claims <u>1-32</u>	YES
	Claims <u>NONE</u>	NO
Industrial Applicability (IA)	Claims <u>1-32</u>	YES
	Claims <u>NONE</u>	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-9 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest an emitter of a thyristor is connected to a first MOS transistor and the gate of the thyristor is connected to a second MOS transistor.

Claims 10-13 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a packaged MOS transistor is connected to the cathode terminal of the thyristor.

Claims 14-16 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a first MOS transistor is connected to the emitter of the thyristor and a second MOS transistor is connected to the gate of the thyristor. In addition, a charge storage device is connected in parallel with the second MOS transistor between the cathode terminal and the thyristor gate.

Claims 17 and 18 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a first die comprising a gate-turn off thyristor is connected to a second die having a MOS transistor. The cathode terminal of the thyristor is connected to the drain terminal of the MOS transistor.

Claims 19-32 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a gate turn-off thyristor device package comprising a first metal plate, a second metal plate and a third metal plate. A thyristor is sandwiched between the first and second metal plates and a first MOS transistor and a second MOS transistor formed on the second metal plate. The first MOS transistor is connected to the emitter of the thyristor and the second MOS transistor is connected to the gate of the thyristor.

----- NEW CITATIONS -----
NONE

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US98/20594

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The description is objected to as containing the following defect(s) under PCT Rule 66.2(a)(iii) in the form or contents thereof:

There is no reference numeral 22 (page 5, line 26) in fig. 1A.

There is no P base 74 (page 9, line 18) in fig. 3A.

There is no MOSFET 158 (page 15, line 19) in fig. 7A.

The NMOS 188 and the PMOS2 190 do not share the same gate 196 and the cathode contact 192 (page 17, lines 6-8).

There is no G1 and terminal B (page 21, line 15) in figs. 17A-17F.

There is no C 600 (page 22, line 8) in fig. 18.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US98/20594

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 27-30 and 31 are objected to as lacking clarity under PCT Rule 66.2(a)(v) because practice of the claimed invention is not adequately described in writing, as required under PCT Rule 5.1(a)(iii), for the reasons set forth in the immediately preceding paragraph.

The written description never discloses the MOS devices comprise a diode as claimed in claim 27.

The written description never discloses the MOS devices comprise a diode connected in parallel with a capacitor as claimed in claim 28.

The written description never discloses the MOS devices comprise a Zener diode connected in parallel with a capacitor as claimed in claim 29.

The written description never discloses the MOS devices comprise a transistor connected in parallel with a capacitor as claimed in claim 30.

The written description never discloses the claimed subject matter as claimed in claim 32.

Claims 14-16 and 19-22 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because the claims are indefinite for the following reason(s):

Claim 14, line 12, "turned of" is not understood.

Claim 19, line 7, "said ETO device package" has no antecedent basis.

PATENT COOPERATION TREATY

WHITHAM, CURTIS & WHITHAM

From the INTERNATIONAL SEARCHING AUTHORITY

To: KEVIN A. REIF
WHITHAM, CURTIS & WHITHAM
RESTON INTERNATIONAL CENTER
11800 SUNRISE VALLEY DRIVE, SUITE 900
RESTON VA 20191

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

Date of Mailing
(day/month/year)

22 JAN 1999

Applicant's or agent's file reference

VTIP 96-037

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT/US98/20594

International filing date
(day/month/year)

30 SEPTEMBER 1998

Applicant

VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.

1. ☒ The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90 bis 1 and 90 bis 3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

for STEVEN LOKE

Telephone No. (703) 308-4920

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference VTIP 96-037	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/US98/20594	International filing date (<i>day/month/year</i>) 30 SEPTEMBER 1998	(Earliest) Priority Date (<i>day/month/year</i>) 30 SEPTEMBER 1997
Applicant VIRGINIA TECH INTELLECTUAL PROPERTIES, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (See Box I).

2. ☐ Unity of invention is lacking (See Box II).

3. ☐ The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.
☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ transcribed by this Authority.

4. With regard to the title,

☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☐ the text is approved as submitted by the applicant.
☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:
 Figure No. 1A

☐ as suggested by the applicant. ☐ None of the figures.
☐ because the applicant failed to suggest a figure.
☒ because this figure better characterizes the invention.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

A family of emitter controlled thyristors employ plurality of control schemes for turning the thyristor on and off. In an embodiment of the invention a family of thyristors are disclosed all of which comprise a pair of MOS transistors [10, 20], the first of which is connected in series with the thyristor [2] and a second which provides a negative feedback to the thyristor gate. A negative voltage applied to the gate of the first MOS transistor [10] causes the thyristor to turn on to conduct high currents. A zero to positive voltage applied to the first MOS gate causes the thyristor to turn off. The negative feedback insures that the thyristor only operates at its breakover boundaries of the latching condition with the NPN transistor portion of the thyristor operating in the active region. Under this condition, the anode voltage V_a continues to increase without significant anode current increase.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/20594**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : H01L 29/74, 31/111

US CL : 257/107, 133, 135, 138, 139, 140, 146, 147, 163, 177

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 257/107, 133, 135, 138, 139, 140, 146, 147, 163, 177

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NoneElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
None**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,719,411 A (AJIT) 17 February 1998, col. 4, line 28 to col. 12, line 60.	1-9
A	US 5,497,011 A (TERASHIMA) 05 March 1996, col. 4, line 60 to col. 9, line 60.	1-9
A	US 5,614,737 A (PICCONE) 25 March 1997, col. 3, line 3 to col. 7, line 14.	10-13, 17, 18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
29 DECEMBER 1998

Date of mailing of the international search report

22 JAN 1999

Name and mailing address of the ISA/US
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Authorized officer

BOB STEVEN LOKE *10 July*
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